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# Reproductive periodicity of the Chiton *Acanthopleura hirtosa* on intertidal platforms in the Perth area of Western Australia

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## ABSTRACT

The reproductive periodicity of populations of *Acanthopleura hirtosa* on three intertidal platforms in the Perth metropolitan area was studied using both gonad indices and histological analysis of gonad tissue. Both methods showed that the animals spawned in a single discrete period from April to June. The largest influx of juveniles into the population occurred from June to August, but recruitment was at a low level, suggesting that the animals survive for at least two years. Reproductive periodicity of *A. hirtosa* is compared with that known for other chitons.

## INTRODUCTION

During the summer of 1981/82 a research program was begun into the molluscs of intertidal beachrock platforms in the Perth metropolitan area. The initial objective was to quantify the hypothesis that a significantly greater component of the mollusc assemblages on platforms at the western end of Rottnest Island was of tropical species than occurred on the inshore platforms of the metropolitan coastline (Wells, 1985). With the closure of the platforms to fishing of abalone and other gastropods in the summer of 1982, the research was expanded into a three year study to examine molluscan assemblages on the platforms to provide basic information for fisheries scientists to use in formulating management policies for the platforms. One early suggestion was that seasonal closures could be used to protect platform species during the reproductive season. However, most of the research on reproductive periodicity of platform species, including molluscs, has been done at Rottnest I. (see Black and Johnson, 1983) and little is known of reproductive seasonality on inshore platforms. Only three species had been studied: *Brachidontes ustulatus*

(Lamarck, 1819) (Wilson and Hodgkin, 1967); *Turbo torquatus* Gmelin, 1790 (Joll, 1980); and *Nodilittorina unifasciata* (Gray, 1825) (Wells, 1984). To develop further information on reproductive periodicity of molluscs four additional species were examined. The four species were studied in separate years, partially by students from the Western Australian Institute of Technology, and used differing techniques. Because of this data for the four species are being presented in a series of separate papers: *Haliotis roei* Gray, 1827 (Wells and Keesing, in prep.); *Cantharidus pulcherrimus* (Wood, 1828) (Wells and Keesing, 1987); and *Patelloida nigrosulcata* (Reeve, 1825) (Wells and Keesing, in press). The present paper reports on the reproductive periodicity of the chiton *Acanthopleura hirtosa* (Blainville, 1825).

Nine species of chitons were found on the platforms during the study. Most were small forms present in low density and biomass, but two large species, *A. hirtosa* and *Onithochiton quercinus* (Gould, 1846), were important components of the fauna of the bare zone at the seaward edge of the platforms. The relative importance of *A. hirtosa* and *O. quercinus* varied considerably on the different platforms: *O. quercinus* was dominant at Garden Island and *A. hirtosa* at both Trigg Island, Cottesloe, and Waterman. Because two of these platforms (Trigg I. and Cottesloe) are heavily affected by human activity, *A. hirtosa* was selected for study.

In addition to its importance in the bare zone *A. hirtosa* is also common at the base of the limestone cliffs at the landward margin of the platforms. *A. hirtosa* is endemic to Western Australia, with a range of from Esperance to Shark Bay. Aside from remarks on its taxonomy, the only published information on *A. hirtosa* is a paper on its temperature tolerance by Kenny (1958). For many years *A. hirtosa* was placed in the monospecific genus *Clavarizona*, but it was recently transferred to *Acanthopleura* (Ferreira, 1986).

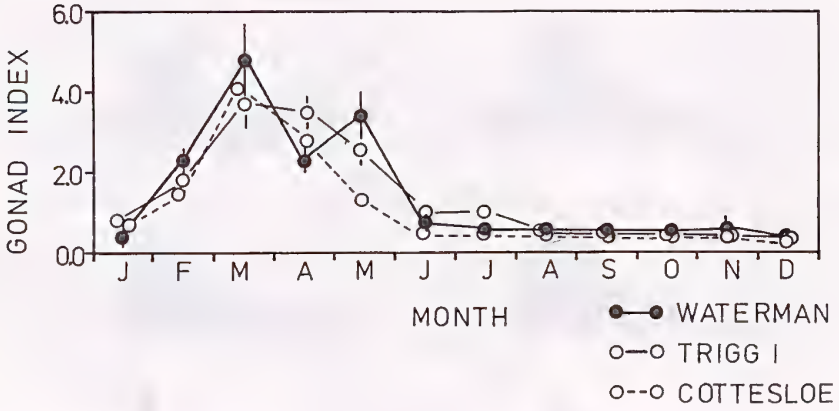
## MATERIALS AND METHODS

Size frequency data on *A. hirtosa* were collected monthly from January to December 1985 at the base of the cliffs at Waterman, Trigg I. and Cottesloe. Because these chitons adhere tightly to the rock surface it was not possible to measure their length *in situ* with accuracy. Instead maximum width of the widest shell plate was measured with calipers to the nearest 1 mm. All data presented relate to shell width. A sample of 39 individuals over the full size range of the species was collected at Trigg I. on 28 June 1985. The animals were relaxed and both plate width and total length measured. The data were fitted to a line of best fit and produced the equation $Y = 1.47 + 2.02X$ where X is width in mm and Y is length in mm. The equation was statistically significant and had an r value of 0.97.

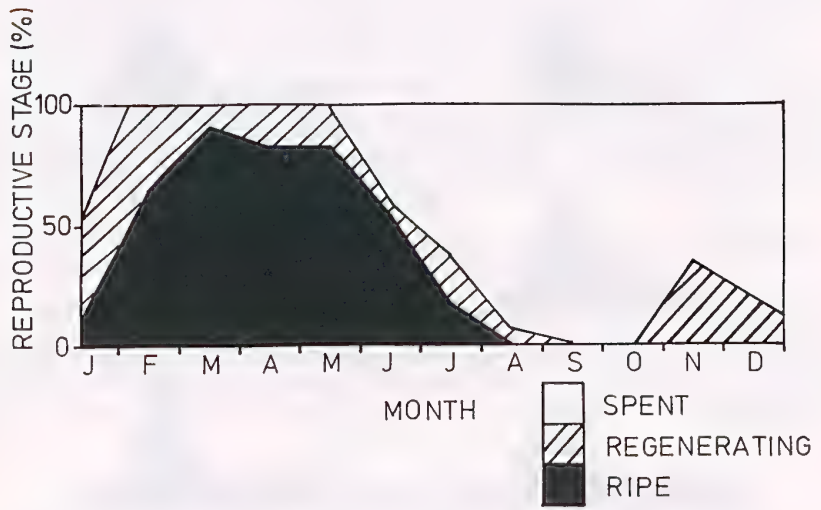
To examine reproductive periodicity 10 *A. hirtosa* were collected monthly from each platform, in areas not used for the size frequency measurements. Larger chitons at least 15 mm in plate width were used. The animals were preserved in 10% formalin and total wet weight later measured on a Sartorius electronic balance. The gonads were then dissected out and weighed separately. The gonad index was calculated as the ratio of gonad weight divided by total weight multiplied by 100. To examine histological state the gonads were then fixed in Bouin's solution for 12 hours, dehydrated through an alcohol series, cleared in xylene, embedded in paraffin wax and sectioned at 7 $\mu$m. The sections were stained with haematoxylin and eosin. The slides were examined microscopically and assigned to reproductive states of ripe, spent, and regenerating. As sample sizes were small and no differences between platforms were observed data on gonad state from the three platforms were pooled.

## RESULTS

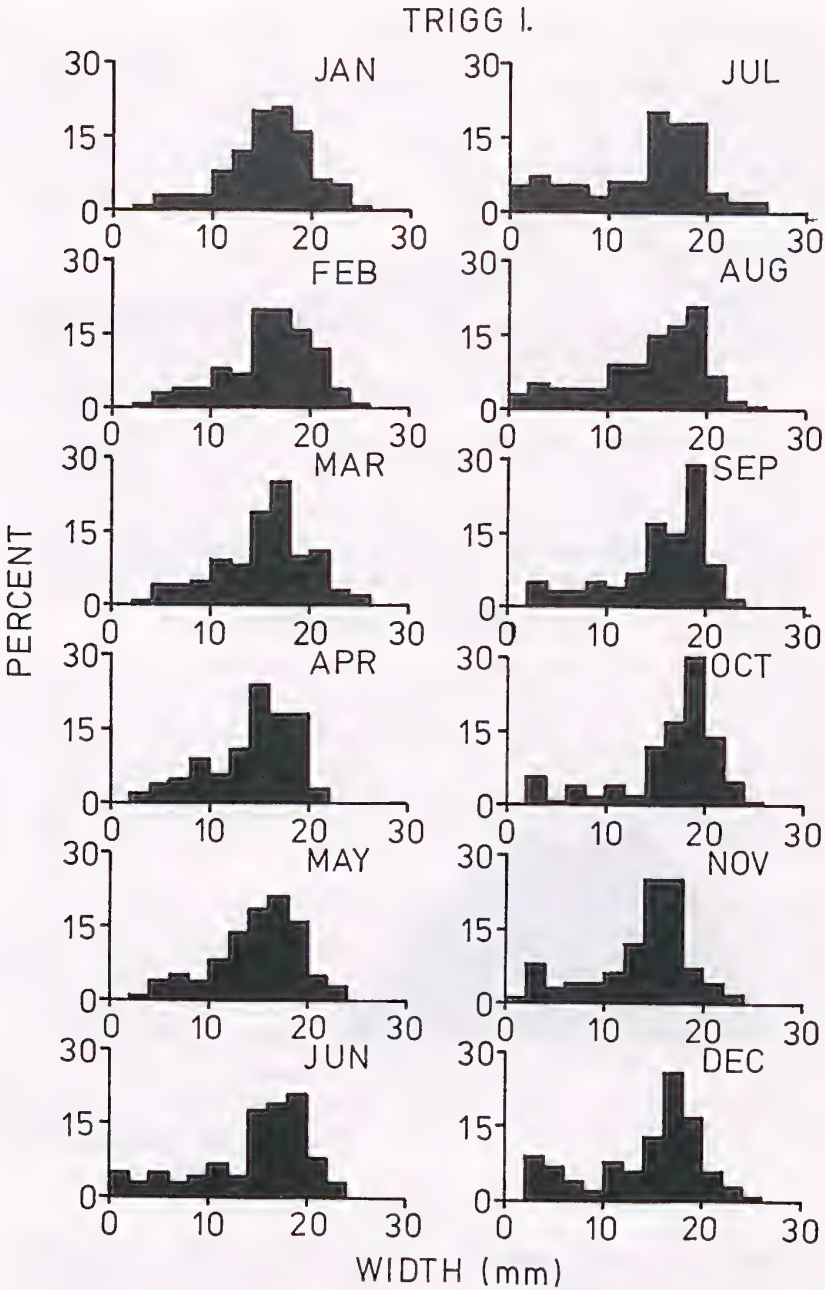
The gonad index was below 1.0 for *A. hirtosa* on all three platforms at the beginning of sampling in January 1985 (Figure 1). The index increased to about 2.0 by February and 4.0 in March. The index then declined steadily from April to June, when it reached 0.7, indicating that spawning had taken place during this period. For the remainder of the year the gonad index remained low, in the region of 0.5. The pattern was similar for all three platforms, with Waterman having the highest gonad index of 4.8 in March, followed by a decline to 2.3 in April and a recovery to 3.4




Gonad index of *Acanthopleura hirtosa* collected at monthly intervals on three intertidal platforms in the Perth metropolitan area from January to December 1985. Means ± 1 S.E. are shown. Where no S.E. is shown the error was smaller than the circle showing the mean.




Reproductive states of *Acanthopleura hirtosa* collected at monthly intervals on intertidal platforms in the Perth metropolitan area. Data from Waterman, Trigg I. and Cottesloe have been pooled.




Size frequency characteristics of *Acanthopleura hirtosa* at Trigg I. at monthly intervals from January to December 1985.

in May. Despite the greater variability at Waterman the general pattern matches that found at Trigg I. and Cottesloe.

Data for reproductive state (Figure 2) closely parallel the gonad index. At the beginning of sampling in January 1985 four animals were ripe, 13 were spent and 13 regenerating. By February 19 were ripe and in March 27 of 30 were ripe. The number of ripe animals remained high until May, when 25 were ripe and then declined steadily until August, when there were no ripe individuals. No ripe animals were found after July. All animals in September and October were spent; some regenerating individuals were found in November and December. These data suggest that *A. hirtosa* spawned from May to July, while the gonad index suggests spawning occurred from April to June.

The size frequency data show that except for small numbers of juveniles in the second half of the year the populations of *A. hirtosa* on the three platforms were unimodal, with modes occurring in the 15-20 mm plate width range. The maximum recorded width was 28 mm, which indicates a length of 58 mm. Histograms for the Cottesloe and Waterman platforms show that the populations were composed of mature individuals throughout the year and there was no period of major recruitment into the population during the year. The largest influx of small individuals occurred at Trigg I. in the period of June-August (Figure 3).

## DISCUSSION

Pearse (1979) has recently summarized the available studies on reproductive periodicity in chitons. Most species have a single discrete reproductive season which may be short or last for several months. Superimposed on the annual cycle may be short term fluctuations in spawning intensity on a monthly or semimonthly basis. Populations of a single species in different geographic areas may have different breeding cycles (Glynn, 1970; Pearse, 1979). Sufficient data are available for only two areas for reproductive periodicity of a group of species to be compared: in the temperate waters off the west coast of North America most chiton species studied spawn in the coldest part of the year (late winter and spring) (Pearse, 1979), while in the tropical waters off Puerto Rico the period of greatest spawning activity was the warmest season (autumn) (Glynn, 1970).

*A. hirtosa* off Perth spawns in a discrete period of three months during the autumn, when water temperatures are still warm. No attempt was made to search for short term variations in spawning intensity, nor for variations in populations from different geographical areas. The species occurs over a wide geographical range, from Esperance on the south coast to Shark Bay on the west coast, in which there are substantially different temperature regimes, and different reproductive seasonality in various areas would not be unexpected.

A number of chitons have been reported to brood embryos, including several species in southern Australia (Turner, 1978); no such brooding behaviour was found in *A. hirtosa*.

Few data are available on the life expectancy of chitons, but those which have been studied live for only a few years (Pearse, 1979). Very few young individuals entered the population of *A. hirtosa* on Perth platforms in 1985, precluding an estimate of growth rate and time required to reach maturity. The size frequency graphs for all months showed that the population was comprised primarily of large individuals. This shows that *A. hirtosa* lives for at least two, and probably more, years.

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